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Extramedullary vs Intramedullary Fixation for Subtrochanteric Femur Fracture-Outcomes

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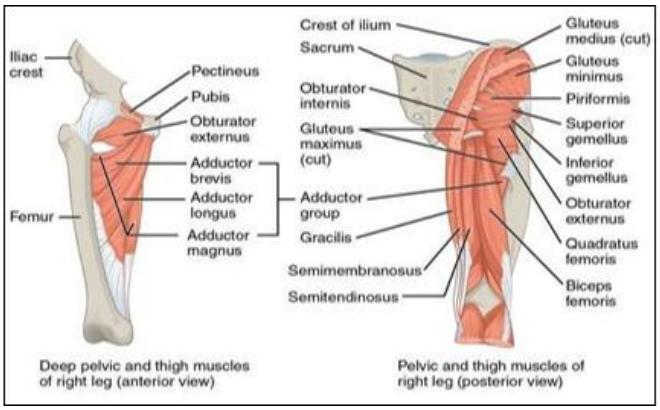
Abstract: ***Aim**: The objective of this study to assess the Outcomes of treatment of subtrochanteric femur fracture treated with extramedullary and intramedullary fixation. **Introduction**: Subtrochanteric femur fractures are difficult to treat due to strong deforming forces at the fracture site, tenuous blood supply and the immense load-bearing forces exerted through the peri-trochanteric region. Adequate reduction and stable fixation are paramount when treating these fractures to optimize patient outcomes. **Materials and methods**: This study was conducted during November 2022 to may 2024. Total 30 patients with subtrochanteric femur fracture were operated and were followed.21 underwent with Long PFN, 2 patients with DCS, 3 with DHS and 4 gamma nail. All the patients were followed up with serial radiographs post operatively at 1,3,6 ,12 and 24 months. Subjectively functional outcome evaluation done by harris hip score. **Results**: The data presents a comparison of the mean operating times across different implants used for treating subtrochanteric femur fractures. The Long PFN recorded the shortest average operating time (67.50 minutes), followed closely by the GN (71.19 minutes). The highest mean blood loss was observed with the DCS (145.00 ml), followed by DHS (126.67 ml), indicating more invasive procedures. In contrast, the Long PFN (67.50 ml) and GN (77.14 ml) had notably lower blood loss, suggesting less surgical trauma. The Harris Hip Score at 3 months postoperatively shows Long PFN demonstrated the highest mean score (71.50), followed closely by GN (69.52), indicating slightly better early hip function. DHS and DCS showed slightly lower scores of 68.67 and 67.00 respectively. The assessment of radiological union time among the study participants shows that most fractures united between 16 and 18 weeks. Specifically, 13 patients (43.33%) achieved union at 18 weeks, followed by 10 patients (33.33%) at 16 weeks. A smaller number showed union at 20 weeks (20.00%), and only 1 patient (3.33%) at 17 weeks. **Conclusion**: Subtrochanteric fractures of the femur remain one of the most challenging injuries in orthopedic trauma, often resulting from high-energy trauma in younger adults or low-energy falls in the elderly. This study comprehensively evaluated the surgical and radiological outcomes of four commonly used implants: Dynamic Condylar Screw, Dynamic Hip Screw, Gamma Nail, and Long Proximal Femoral Nail, In the treatment of 30 patients with subtrochanteric femur fractures. The Long PFN group demonstrated the shortest mean operative time, least intraoperative blood loss, union rate and the highest functional scores across all postoperative intervals. the consistent superiority in clinical parameters suggests that Long PFN is more efficient and less invasive than extramedullary alternatives like DCS and DHS. This study underscores the clinical and surgical efficacy of intramedullary fixation, particularly Long Proximal Femoral Nail, in the management of subtrochanteric femur fractures. The implant demonstrated superior performance across nearly all parameters. Based on the results, Long PFN should be considered the implant of choice in most subtrochanteric fractures, especially those with unstable configurations., the findings support a paradigm shift toward evidence-based implant selection to enhance patient recovery and reduce the burden of complications in orthopedic trauma care.*

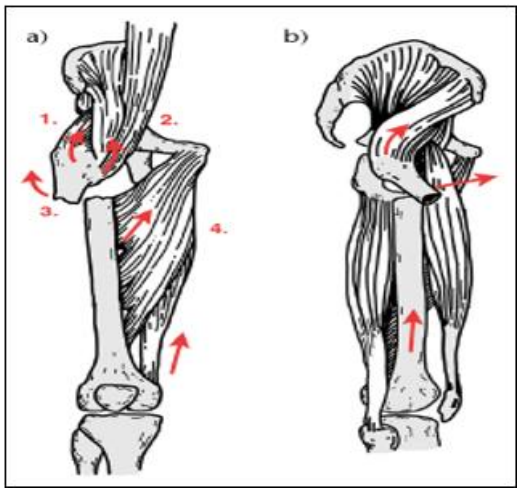
Keywords: Subtrochanteric fracture, older adults, DHS, DCS, GN, Harris hip score, merle D'aubigne score

1. Introduction

Subtrochanteric fractures of the femur are among the most common and complex types of fractures in orthopedic trauma, occurring just below the lesser trochanter and extending to the femoral shaft. These fractures are generally classified as those occurring between 1 and 5 cm below the lesser trochanter, a region that is biomechanically critical because it is subjected to considerable forces during normal activity. Subtrochanteric fractures represent a significant challenge in terms of both management and rehabilitation due to the high mechanical stress on the femur and the surrounding musculature. The incidence of subtrochanteric fractures has increased with the aging population and the prevalence of osteoporosis, a condition that weakens bones and makes them more susceptible to fractures even with low-energy trauma. High-energy trauma, such as motor vehicle accidents and falls from height, can also cause subtrochanteric fractures, especially in younger patients.



Muscular attachment of femur



Deforming forces of proximal femur

The treatment of subtrochanteric fractures has evolved significantly over the last few decades. Initially, these fractures were managed through conservative means, including traction and bed rest, but over time, surgical fixation became the preferred method due to the complications associated with non-operative treatment, such as malunion, nonunion, and prolonged disability. Surgical methods aim to restore the anatomy of the femur and provide stability to allow early mobilization and weight-bearing, which is crucial for faster recovery and reduced risk of complications. Among the most widely accepted surgical treatments are the use of intramedullary nails such as Proximal Femoral Nailing (PFN), Gamma nails, DCS and DHS, which offer excellent mechanical stability for various types of subtrochanteric fractures.

Subtrochanteric fractures are commonly associated with significant soft tissue injury and vascular compromise, which can complicate the treatment process. In particular, fractures in this region often involve the disruption of muscles that play a key role in stabilizing the hip and femur. The need for prompt and accurate surgical intervention becomes even more critical in these cases to minimize the risk of complications such as infection, poor healing, or complications related to muscle function. Furthermore, achieving proper alignment and fixation of these fractures is vital to prevent long-term complications, such as the development of post-traumatic arthritis, which can severely impair the patient's quality of life.

The selection of the appropriate surgical approach for subtrochanteric fractures depends on various factors, including the patient's age, bone quality, fracture pattern, and the presence of any comorbidities. The ideal surgical method should provide stable fixation, restore the anatomy of the femur, and facilitate early mobilization. Despite advancements in surgical techniques, complications are still common in subtrochanteric fractures. These include infection, nonunion, malunion, and the failure of the implant. Research on the effectiveness of different implants and fixation techniques continues to evolve, with ongoing studies focusing on improving the surgical outcomes and reducing complication rates.

In addition to radiological outcomes, clinical outcomes, such as the time to union, complication rates, and functional recovery, are essential measures of treatment success. Functional recovery includes the ability of the patient to resume normal activities, such as walking and climbing stairs, as well as the absence of pain or discomfort in the affected leg. The goal of surgical intervention is to achieve the best functional outcome possible, which requires not only effective fracture fixation but also appropriate rehabilitation and post-operative care.

Aim of the study

- To study Subtrochanteric fractures
- To study management and outcomes of Subtrochanteric fractures.
- To reestablish the anatomy of subtrochanteric fractures perfectly by operative treatment with intramedullary and extramedullary implants.
- To compare results with standard studies and draw conclusions.

2. Materials and Methods

Study design

The study was designed as a prospective, observational, and hospital-based study. The purpose of the study was to assess the outcomes of various surgical interventions used to treat subtrochanteric fractures of the femur in patients admitted to the Navodaya Medical College Hospital and Research Centre, Raichur. The study involved patients who satisfied specific inclusion criteria and who underwent surgical fixation for their fractures. The primary objective of the study was to evaluate the functional and radiological outcomes of the surgical procedures employed, while also monitoring any complications associated with the procedures. The study aimed to follow up with patients over an 18-month period, ensuring that all participants were appropriately monitored throughout their recovery phases.

Inclusion Criteria:

- Patients aged between 18 to 70 years.
- Diagnosis of subtrochanteric fracture of the femur, confirmed by radiographic imaging.
- Patients who are fit for surgery, based on preoperative assessment.
- Patients who provided informed consent to participate in the study

Exclusion Criteria:

- Fractures involving the piriformis fossa.
- Stable intertrochanteric fractures.
- Open hip fractures or compound fractures.
- Pathological fractures caused by tumors or infections.
- Pediatric fractures (before physeal closure).
- Patients who refused to participate or provide consent for the study.
- Patients with severe comorbidities that contraindicate surgery or interfere with the study outcomes, such as uncontrolled diabetes or severe cardiovascular conditions.

Study Procedure

The study involved a comprehensive preoperative and postoperative assessment. Upon admission to the hospital,

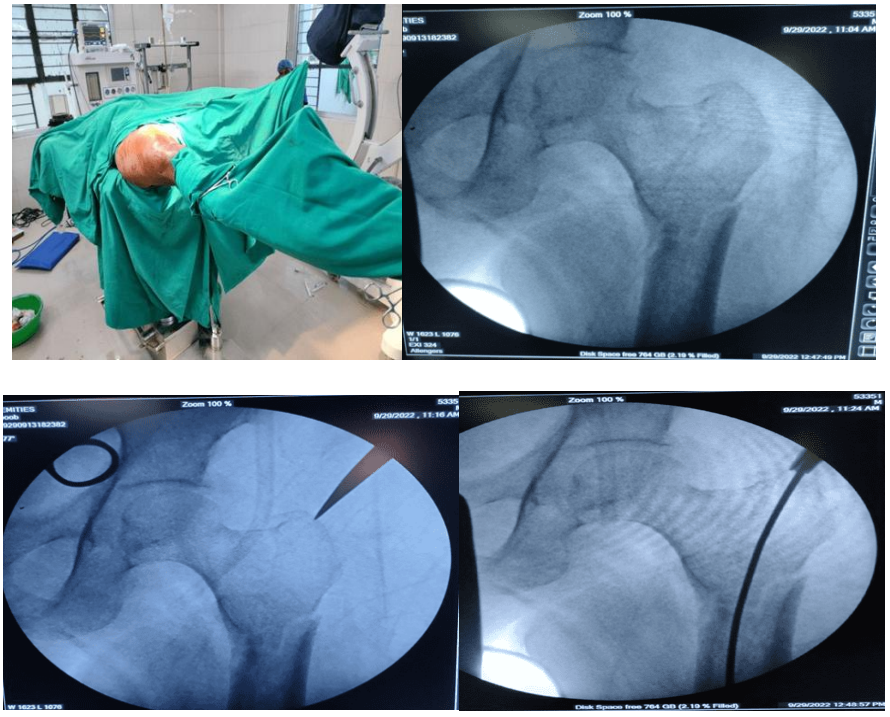
patients were thoroughly evaluated through clinical examinations and radiological imaging, including X-rays of the pelvis, affected hip, and femur. The fracture was classified based on its location and type. Preoperative investigations, including blood tests (CBC, liver and renal function tests), were carried out to assess the patient's overall health and suitability for surgery. The appropriate surgical fixation technique was then selected based on the fracture pattern, bone quality, and the patient's general health. After surgery, patients were closely monitored for signs of complications. Postoperative assessments were conducted regularly, including repeat radiological imaging to monitor healing progress. Functional recovery was assessed through regular follow-up visits, during which pain, mobility, and strength were evaluated.

Study Data Collection

Data collection involved both qualitative and quantitative methods. Patient demographic data, including age, sex, and comorbidities, were collected from clinical records. Preoperative and postoperative X-rays were reviewed to assess fracture alignment, reduction, and fixation device placement. The clinical evaluation was conducted at regular intervals post-surgery to assess functional recovery, complications, and pain levels. Patient-reported outcomes, such as the Harris Hip Score (HHS), were used to measure recovery and function over time. Additionally, complications such as infection, nonunion, and implant failure were recorded. Follow-up data were collected at 6 weeks, 3 months, 6 months, and 12 months post-surgery to monitor the progress of healing and functional outcomes.

Surgical Procedure

Under Spinal or epidural anesthesia, patient positioned Supine on a standard fracture table. Rest operating foot in a padded foot holder and use a padded perineal post, unaffected limb is kept in hip flexion and abduction over a side support. The pelvis must lie in the horizontal position. Adduct the affected femur to allow access to trochanteric region. Tilt the trunk away from the operating side and strap the arm of the same side across the chest of the patient. Place the uninjured side flexed and abducted to allow unimpeded access to the image intensifier between the legs. Image intensifier is placed opposite to the side being operated. closed reduction and internal fixation done for long PFN and GN, and open reduction and fixation for DHS and DCS.



Intra OP pics

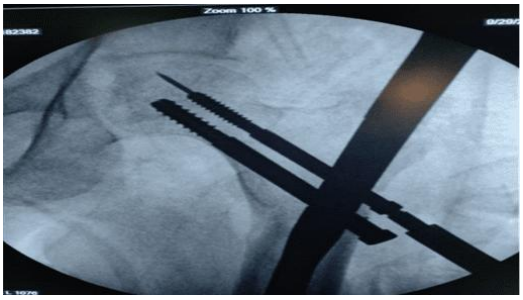
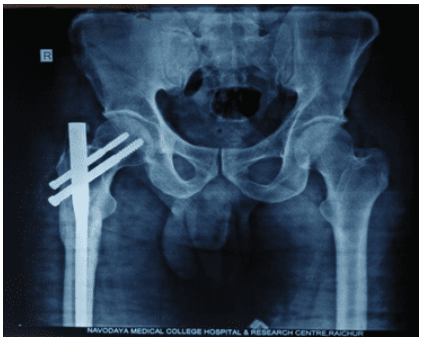


Figure 3: Intra operative image



Follow up 4 month Xray

Functional Outcome

Pre op xray

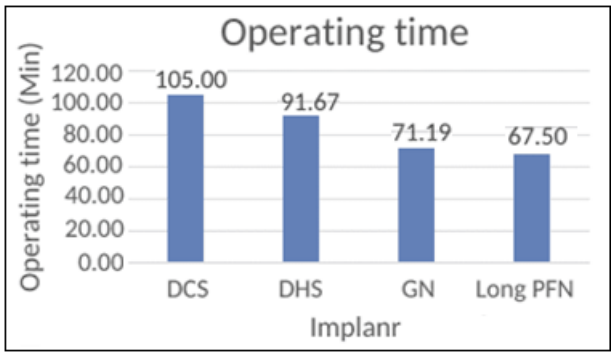
immediate post op xray

3 month post op xray

6 month post op xray

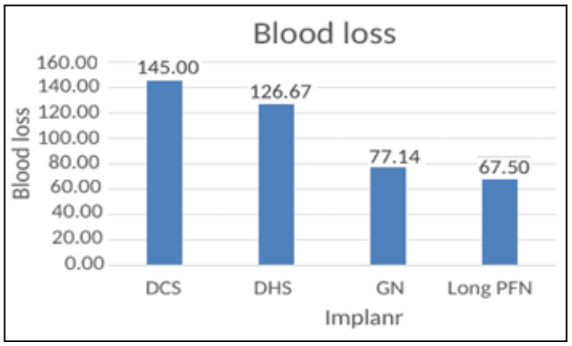
3. Results

The data presents a comparison of the mean operating times across different implants used for treating subtrochanteric femur fractures. the Long PFN recorded the shortest average operating time (67.50 minutes), followed closely by the GN (71.19 minutes). In contrast, the DCS showed the longest duration (105.00 minutes). A statistically significant difference ($P < 0.001$) indicates that the variation in operating times among the implants is not by chance, suggesting Long PFN and GN are more efficient surgical options in terms of time.



Graph 2: Mean Operating Time for Various Implant Modalities

The comparison of intraoperative blood loss among various implants used for subtrochanteric femur fracture fixation shows significant variation. The highest mean blood loss was observed with the DCS (145.00 ml), followed by DHS (126.67 ml), indicating more invasive procedures. In contrast, the Long PFN (67.50 ml) and GN (77.14 ml) had notably lower blood loss, suggesting less surgical trauma. The P-value (< 0.001) confirms that these differences are statistically significant, reinforcing that intramedullary implants like Long PFN and GN are associated with reduced blood loss compared to extramedullary devices like DCS and DHS.



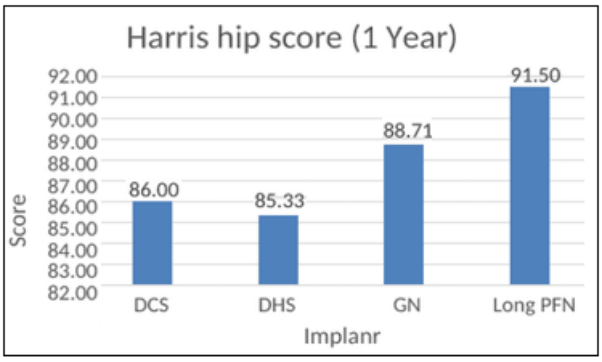
Graph 2: Mean Blood Loss for Various Implant Modalities

The Harris Hip Score

At 3 months postoperatively shows relatively comparable functional outcomes among the different implant groups used for subtrochanteric femur fractures. Long PFN demonstrated the highest mean score (71.50), followed closely by GN (69.52), indicating slightly better early hip function. DHS and DCS showed slightly lower scores of 68.67 and 67.00, respectively. This suggests that while intramedullary implants may show a trend toward better early function.

At 6 months postoperatively, continued improvement was observed in all implant groups, with Long PFN again achieving the highest mean HHS (82.00 ± 1.63), followed by GN (79.24 ± 4.07), DCS (78.00 ± 2.83), and DHS (77.33 ± 4.16). Despite these improvements, the difference among the groups remained statistically non-significant ($P = 0.408$), suggesting that all modalities provide adequate mid-term functional recovery.

By 1 year postoperatively, all patient groups demonstrated significant functional gains. The highest average HHS was recorded in the Long PFN group (91.50 ± 1.91), followed by GN (88.71 ± 3.70), DCS (86.00 ± 5.66), and DHS (85.33 ± 5.03). Though the P-value (0.159) did not indicate statistical significance, the consistent trend in favor of intramedullary implants is evident.



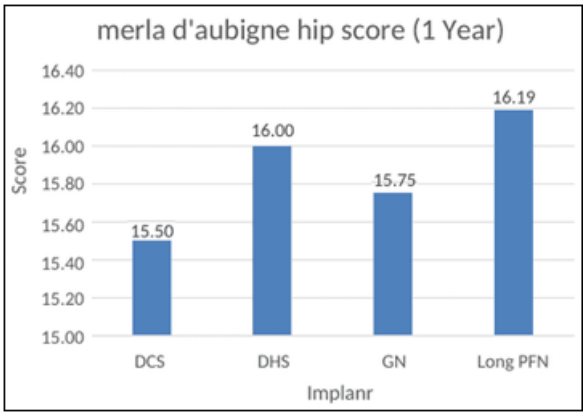
Graph 5: Harris Hip Score (1 year) for Various Implant Modalities

Merle d'Aubigné Hip Score

at 3 Months The early postoperative evaluation of hip function using the Merle d'Aubigné hip score at 3 months revealed the best outcomes with Long PFN (13.50 ± 0.58) and GN (13.48 ± 0.75), followed by DHS (13.00 ± 0.00) and DCS (12.00 ± 0.00). The difference was statistically significant (P = 0.042), emphasizing the early functional superiority of intramedullary devices.

At 6 months postoperatively, all four implant groups exhibited continued functional recovery based on the Merle d'Aubigné hip score. The Long PFN group showed the highest average score (15.38 ± 0.86), with both GN and DHS scoring 15.00 ± 0.82 and 0.00, respectively, and DCS trailing at 14.00 ± 0.00. The P-value (0.144) indicates that while the numerical trend favors Long PFN, the difference is not statistically significant.

By 12 months, functional outcomes had improved significantly across all groups. The highest mean score was noted in the Long PFN group (16.19 ± 0.60), followed by DHS (16.00 ± 0.00), GN (15.75 ± 0.50), and DCS (15.50 ± 0.71). Although the P-value (0.263) did not reflect statistical significance, the consistent superiority of Long PFN remained evident.



Graph 8: Merle d' Aubigne Hip Score (1 year) for various Implant Modalities

Postoperative Rehabilitation and Weight-Bearing Protocols Another influential factor in recovery was the postoperative weight-bearing protocol. Intramedullary implants allowed earlier partial and full weight-bearing, typically initiated by 3–6 weeks post-op, whereas DCS and DHS often required delayed loading due to concerns about stability. In our study, patients treated with Long PFN showed faster recovery milestones, such as independent walking and stair climbing, by the 3-month mark, compared to DCS where such activities were often delayed until 4–6 months.

One of the key differentiators observed in this study was the biomechanical advantage of intramedullary implants such as Long PFN and GN, which led to superior early function, lower intraoperative blood loss, and shorter surgery times. These benefits stem from the central location of the nail within the femoral canal, providing a load-sharing mechanism that mimics the natural axis of the femur.

4. Discussion

Subtrochanteric fractures of the femur remain one of the most challenging injuries in orthopedic trauma, often resulting from high-energy trauma in younger adults or low energy falls in the elderly. The surgical treatment of these fractures is complex due to the biomechanical stresses at the subtrochanteric region and the need for implants that can provide both axial and rotational stability while promoting early mobilization. This study comprehensively evaluated the surgical and radiological outcomes of four commonly used implants: Dynamic Condylar Screw (DCS), Dynamic Hip Screw (DHS), Gamma Nail (GN), and Long Proximal Femoral Nail (Long PFN), in the treatment of 30 patients with subtrochanteric femur fractures. The comparative analysis of intraoperative parameters, functional outcomes at multiple follow-up intervals, and fracture union times has yielded several important insights that can inform surgical decision-making. The findings of this study clearly highlight the advantages of intramedullary devices, particularly Long PFN, in treating subtrochanteric femur fractures. The Long PFN group demonstrated the shortest mean operative time, least intraoperative blood loss, and the highest functional scores across all postoperative intervals. Although not all differences reached statistical significance, the consistent superiority in clinical parameters suggests that Long PFN is more efficient and less invasive than extramedullary alternatives like DCS and DHS. The reduced operative time and blood loss not only imply improved surgical efficiency but also lower the risk of perioperative complications, which is especially important in polytrauma patients or those with medical comorbidities. These intraoperative advantages further translated 95 into better early postoperative recovery, with Long PFN patients achieving higher Harris Hip Scores and Merle d'Aubigné scores at 3 months. This is critical because early mobilization is directly linked to reduced morbidity, shorter hospital stays, and improved quality of life. Functional outcomes at 6 months and 1 year further reinforced the long-term benefits of intramedullary nailing. Although the differences among groups narrowed with time and statistical significance was not reached, Long PFN continued to show the best mean values in both functional scoring systems. The maintenance of this functional lead indicates not only initial success but also the sustained efficacy of the implant in allowing the patient to regain near-normal hip function. This is particularly important in younger patients who aim to return to work or physical activity and require a fixation method that supports robust and durable rehabilitation. Additionally, radiological outcomes also favored Long PFN, with most patients achieving union between 16 and 18 weeks—consistent with

expected healing timelines. No patient experienced non-union or implant failure, reflecting the biomechanical strength and clinical reliability of the device. From a demographic and clinical perspective, the study revealed a predominance of fractures in males under the age of 50, mostly due to high-energy mechanisms like road traffic accidents. This supports the hypothesis that younger patients with higher functional demands benefit the most from implants that support early weight bearing and fast recovery. The Russell-Taylor classification showed that the majority of fractures were of the Type IB variant, which are typically more unstable and necessitate implants that can withstand significant axial and rotational forces. Intramedullary nails are particularly well-suited for this purpose, as they align 96 with the mechanical axis of the femur and reduce the moment arm, thus lowering the risk of implant fatigue or mechanical failure. Despite the favorable results, extramedullary implants like DHS and DCS were not without merit. In stable fractures or in settings where intramedullary implants are unavailable, these devices still offer acceptable outcomes, especially when used with meticulous surgical technique and patient compliance with postoperative protocols. However, the longer operative time, greater blood loss, and delayed functional recovery make them less ideal, particularly in unstable fracture configurations or where early mobilization is essential. In conclusion, this study underscores the clinical and surgical efficacy of intramedullary fixation, particularly Long Proximal Femoral Nail, in the management of subtrochanteric femur fractures. The implant demonstrated superior performance across nearly all parameters, including operative efficiency, blood conservation, early and late functional outcomes, and timely radiological union. Based on the results, Long PFN should be considered the implant of choice in most subtrochanteric fractures, especially those with unstable configurations. Furthermore, the integration of fracture classification, patient factors, and surgical planning is vital to optimize outcomes.

5. Conclusion

Intramedullary group demonstrated the shortest mean operative time, least intraoperative blood loss, union rate and the highest functional scores across all postoperative intervals. the consistent superiority in clinical parameters suggests that intramedullary implants are more efficient and less invasive than extramedullary alternatives like DCS and DHS. This study underscores the clinical and surgical efficacy of intramedullary fixation, particularly Long Proximal Femoral Nail, in the management of subtrochanteric femur fractures. The implant demonstrated superior performance across nearly all parameters. Based on the results, Long PFN is the reliable implant of choice in most subtrochanteric fractures, especially those with unstable configurations and has biological and biomechanical advantages. The findings support a paradigm shift towards evidence-based implant selection to enhance patient recovery and reduce the burden of complications in orthopedic trauma care.

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